भारतीय मानक **IS 13360 (Part 9/Sec 8) : 2023**

Indian Standard

प्लास्टिक — परीक्षण पद्धतियाँ

भाग 9 प्रकाशिक गुणधर्म

अनुभाग 8 प्लास्टिक की चद्दरों की पारदर्शिता ज्ञात करना

(पहला पुनरीक्षण)

Plastics — Methods of Test

Part 9 Optical Properties

Section 8 Determination of Transparency of Plastic Sheeting

(First Revision)

ICS 83.140.10

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October 2023 **Price Group 5**

Methods of Sampling and Test for Plastics Sectional Committee, PCD 27

FOREWORD

This Indian Standard (Part 9/Sec 8) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Methods of Sampling and Test for Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

This standard was originally published in 2001. This revision has been undertaken to modify the procedure and calculation clause in the standard.

The attribute of clarity of a sheet, measured by its ability to transmit image-forming light, correlates with its regular transmittance. Sensitivity to differences improves with decreasing incident beam and receptor angle. If the angular width of the incident beam and of the receptor aperture (as seen from the specimen position) are of the order of 0.1° or less, sheeting of commercial interest have a range of transparency of about 10 percent to 90 percent as measured by the method specified in this standard. Results obtained by the use of this test method are greatly influenced by the design parameters of the instruments; for example, the resolution is largely determined by the angular width of the receptor aperture. Caution should therefore be exercised in comparing results obtained from different instruments, especially for samples with low regular transmittance.

Regular transmittance data according to the test method prescribed in this standard correlate with the property commonly known as ‘see-through’, which is rated subjectively by the effect of a hand-held specimen on an observer’s ability to distinguish clearly a relatively distant target. This correlation is poor for highly diffusing materials because of interference of scattered light in the visual test.

While preparing this standard assistance has been derived from ASTM D 1746-15 ‘Standard test method for transparency of plastic sheeting’ issued by American Society for Testing and Materials (ASTM), USA.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Indian Standard

PLASTICS — METHODS OF TESTS

PART 9 OPTICAL PROPERTIES

SECTION 8 DETERMINATION OF TRANSPARENCY OF PLASTIC SHEETING

(First Revision)

1 SCOPE

This standard (Part 9/Sec 8) prescribes the method for the measurement of the transparency of plastic sheeting in terms of regular transmittance (T_r). Although, applicable to any translucent or transparent material, it is principally intended for use with nominally clear and colourless thin sheeting.

2 REFERENCE

The standard given below contain provisions which, through reference in this text, constitute provisions of the standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of this standard:

IS No.	*Title*
IS 13360 (Part 9/Sec 5) : 1999	Plastics — Methods of testing: Part 9 Optical properties, Section 5 Determination of haze and luminous transmittance of transparent plastics

3 TERMINOLOGY

3.1 Definitions

3.1.1 *Transmittance* — The ratio of the flux transmitted by a specimen to the radiant flux incident on the specimen.

3.1.2 *Regular Transmittance* — The ratio of undiffused transmitted flux to incident flux. The regular transmittance may equal the total transmittance but cannot exceed it (for this test method limitations on the geometry of the optical system are specified in 4).

4 APPARATUS

4.1 The apparatus shall consist of a light source, source aperture, lens system specimen holder, receptor aperture, photoelectric detector, and an indicating or recording system, arranged to measure regular transmittance. The system shall meet the following requirements.

4.1.1 An incandescent of or vapour-arc lamp, with a regulated power supply such that fluctuations in light intensity shall be less than ± 1 percent. If an arc lamp is used, an appropriate filter shall be used to limit light only to the spectral range from 540 mm to 560 nm.

4.1.2 A system of apertures and lenses shall be used that will provide a symmetrical incident beam. When measured with the indicating or recording system of the apparatus, using a receptor aperture having a width or diameter subtending an angle of 0.025° ± 0.005° at the plane of the specimen, the incident beam shall meet the following requirements:

Sl No. (1)	*Angle, Degree* (2)	*Maximum Relative Intensity* (3)
i)	0	100
ii)	0.05	10
iii)	0.1	1
iv)	0.3	0.1

The source aperture may be circular or a rectangular slit having a length-to-width ratio of at least 10.

4.1.3 A holder shall be provided that will secure the specimen so that its plane is normal to the axis of the incident beam at a fixed distance from the receptor aperture. Provision must be made for rotating the specimen if slit optics are used. Provision for transverse motion may be provided to facilitate replication of measurements.

4.1.4 An aperture shall be provided over the receptor so that its diameter or width subtends an angle, at the plane of the specimen, of 0.1° ± 0.025°. The image of the source aperture with no specimen in place shall be the same shape as the receptor aperture centered on and entirely within it.

4.1.5 A photoelectric detector shall be provided such that the indicated or recorded response to incident light shall be substantially a linear function and uniform over the entire range from the unobstructed beam (I_o) to 0.01 I_o or less.

4.1.6 Means shall be provided for relatively displacing the receptor or the image of the source aperture (in the plane of the receptor aperture) by at least 1° from the optical axis of the undeviated incident beam; for circular apertures, in two directions at right angles to each other for slit optics, in the direction of the short dimension of the slit.

NOTES

1 This provision is necessary for checking the geometry of the incident beam (4.1.2) and for readjusting for maximum light intensity in the event that the beam is deviated by a specimen with non-parallel surfaces.

2 Apparatus meeting these requirements has been described in the literature, and commercial versions are available.

5 REFERENCE MATERIALS

5.1 Since no regular transmittance standards are known to be available, it is recommended that specimens of glass or other material believed to maintain constant light transmission properties with time be selected that yield different regular transmittance values for use as reference materials.

5.2 Measure the regular transmittance value of each specimen, and label it with the value obtained.

5.3 Keep these reference materials for checking for changes in instrument performance in the future.

6 TEST SPECIMENS

6.1 All specimens shall be nominally colourless (*see* Note) and transparent to translucent, have essentially plane parallel surfaces, and be free of surface or internal contamination.

NOTE — Transparency of coloured or highly reflective materials may be measured by the ratio of T_r/T_t, where T_t, is the total luminous transmittance [*see* IS 13360 (Part 9/ Sec 5)].

6.2 Non-rigid specimens shall be held in a suitable holder so that they are flat and free from wrinkles.

7 CONDITIONING

7.1 Conditioning

Condition the test specimens at 27 °C ± 2 °C and 65 percent ± 5 percent relative humidity for not less than 40 h prior to test those tests where conditioning is required. In cases of disagreement, the tolerances shall be ± l °C for temperature and ± 2 percent relative humidity.

7.2 Test Conditions

Conduct tests in the standard laboratory atmosphere of 27 °C ± 2 °C and 65 percent ± 5 percent relative humidity, unless otherwise specified in the test methods. In cases of disagreement, the tolerances shall be ± l °C and ± 2 percent relative humidity.

8 INSTRUMENT ADJUSTMENT

8.1 Turn the instrument on and allow it to come to a stable operating temperature.

8.2 With the light beam blocked at sample position, set the reading to zero.

8.3 With the light beam unblocked, adjust the reading to a maximum by moving the receptor aperture so that the receptor receives the maximum intensity from the light. Either set this value to 100 or record it as $I_{o.}$

8.4 Check for changes in instrument performance by reading the reference materials prepared in 5.

9 PROCEDURE

9.1 Turn the instrument on and allow it to come to a stable operating temperature.

9.2 With the light beam blocked at sample position, set the reading to zero.

9.3 With the light beam unblocked, set the reading to 100 and record it as I_o.

9.4 Mount a test specimen in the instrument so that it is neither wrinkled nor stretched but centered and normal to the light beam. Record the reading as I_r. Rotate the specimen 90º to measure the directionality of the specimen and record the reading as I_{90}. If no directionality is detected in the specimen, then the test may be performed without 90º rotation.

9.5 Repeat 9.4 for the other two specimens (minimum).

9.6 A test result is the mean of these three reading (minimum) for each angle of rotation. Report the results in one of two ways:

a) per direction; or
b) averaged.

9.7 Individual results must also be reported.

10 CALCULATION

10.1 Calculate the percent regular transmittance, T_r as follows:

$$T_r = 100\,\frac{I_r}{I_o}$$

where

I_r = light intensity with the specimen in the beam; and
I_o = light intensity with no specimen in the beam.

NOTE — No calculation is needed if I_o is set to 100 or a conversion chart or special scale is used to interpret the instrument reading.

10.2 Calculate the test result or average transmittance of the three, or more, readings.

10.3 Calculate the standard deviation of the average transmittance (standard deviation of n readings/$n^{1/2}$).

11 REPORT

11.1 Report the following information:

a) Sample designation;
b) Instrument used;
c) Average regular transmittance (*see* **10.2**) in machine direction and 90° rotation or average of both directions;
d) Number of specimens tested and direction of testing;
e) Standard deviation (*see* **10.3**); and
f) Any measured anisotropy;

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Methods of Sampling and test for Plastics Sectional Committee, PCD 27

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